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ORIGINAL

DESIGN SPECIFICATIONS TO DEVELOP A *PILOTA VALENCIANA* PROTECTION GLOVE

ESPECIFICACIONES DE DISEÑO PARA EL DESARROLLO DE UN GUANTE DE *PILOTA VALENCIANA*

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ABSTRACT

This paper covers the first phase of a project aimed at developing a protective glove for *pilota valenciana*. At present, players do not use specific equipment to

protect their hands, and the lack of scientific knowledge for the development of specific materials is notable. Within this context, we present a study based on questionnaires administered to 100 *pilota valenciana* players (51 playing professionally). The purpose is to establish the design specifications of a future protective glove as well as to determine a standard protection. Some results show that 64% of the players believe their protections to worsen performance and 84% of them spend one hour or more to make them. The need to overcome the disadvantages of the current protections has been proved, and design specifications by players must be kept in mind.

KEY WORDS: Protection, performance, comfort, injuries, glove.

RESUMEN

El presente artículo se corresponde con la fase inicial de un proyecto que tiene como objetivo desarrollar un guante de protección para jugar a *pilota valenciana*. Actualmente, los jugadores no tienen un equipamiento específico de garantía para protegerse las manos y existe una ausencia general de conocimiento científico para desarrollar materiales específicos. En este contexto, se presenta un estudio de encuestas sobre 100 jugadores de *pilota valenciana*, 51 de ellos profesionales, acerca de las protecciones tradicionales que utilizan. El objetivo es definir las especificaciones de diseño de la futura protección así como definir una protección tipo. Algunos de los resultados más destacables indican que el 84% de los jugadores emplean una hora o más en confeccionarse la protección y que 64% de los jugadores consideran que sus protecciones empeoran el rendimiento. Se ha comprobado que las actuales protecciones resultan ineficaces en términos de rendimiento y confort.

PALABRAS CLAVE: Protección, rendimiento, confort, lesiones, guante.

INTRODUCTION

This paper covers the first study phase of a project run by the Sports Section of the *Instituto de Biomecánica de Valencia* (IBV) (Valencia Biomechanics Institute), which ultimately seeks to produce a protective glove for *pilota valenciana*.

Pilota valenciana is a traditional sport well rooted in the Region of Valencia since the time of King James I (13th century). This ball game has survived over time as part of Valencian culture. It is played under different modalities: *escala i corda; raspall; galotxa; llargues* and *frontón valenciano,* all of them characterised by striking the ball with the hand. The first two variants are commonly played in a court called *trinquete* (Llopis, 1999; Millo, 1976; Moreno, 1992; Olaso, 1994; Soldado, 1999).

In both *escala i corda* and *raspall,* players can hold different playing positions: *rest*, *mitger* or *punter*. The *rest* is the player at the furthest point in the court; the *punter* plays forward, while the *mitger* plays from an intermediate position between the other two players in the 'three against three' game.

The ball is 40-50 grams and has a 3 cm diameter. It is made of 3-4 mm thick tanned bull leather and filled with wool. In striking such a hard and heavy ball, players withstand strong impacts on their hands during the striking actions of the game. To absorb the shock, the *pilotaris* protect both their hands before training sessions and matches in a traditional way, using different materials such as sheets or plates, card, thimbles, sticking plaster, Tesamoll® (a material similar to EVA), etc.

Despite the growing professionalization of this ball game, controversy and hand-protection issues continue to exist. These issues can be grouped into three points:

- Injuries and pain on the hands as a consequence of continuous and strong impact. This shortcoming hinders an ongoing, healthy practice of the sport. It must also be pointed out that materials are selected on the basis of tradition and the players' personal experience.

The paper presented by Montaner (2010) on usual injuries and discomfort in *pilota valenciana* players shows a high injury rate (97%). Most of the injuries occur on the hand (66%), this type of injury accounting for the largest percentage of convalescence in players (97%), i.e. a week without playing minimum. If the playing position is considered, *mitgers* are the most injury-prone players (73.53%) if compared to the remaining play positions (65.11%).

In turn, Conca, García, Gimeno, Llopis, Naya and Pérez (2002), and Martínez and Alcántara (2004) refer to *pilota assentada* as the most important and frequent injury in *pilota valenciana.* This injury is a painful callus on the palm caused by an incorrect striking style or by excessive striking on a particular spot.

In similar sports, such as Basque Pelota -with similar actions and strikes- Gámez (2008) also notes the high incidence (90%) of injuries or physical problems, the most frequent being (a) Raynaud's syndrome, (b) oedemas, (c) bruising and (d) deviation of the little finger toward the hand's central axis (Baudet and Laporte, 1994; Laporte, 1996; Letamendia, 1993; Letamendia, 1995). Time spent to put the protections on. Reducing the time it takes to put on the protections would mean optimising training and playing times.

- Inexistence of specific hand protections in line with players' needs, and absence of scientific criteria for their development. This type of knowledge does exist in other sports, thus contributing to creating new products, e.g. footwear for athletics (Divert, Baur, Mornieux, Mayer

and Belli, 2005); American football (Heidt, Dormer, Crawley, Scranton, Losse and Howard, 1996), tennis (Nigg, Luthi and Balhsen, 1989; Schlaepfer, Unold and Nigg, 1983) or basketball (Zhang, Clowers, Kohstall and Yu, 2005). In this particular regard, it is most important to rely on users' opinions about preferences, shortcomings and features in a new product (Alemany, Montaner, Gámez and Redín, 2006; Gámez et al., 2006; Llana, Brizuela, Dura and García, 2002; Pérez, Llana and Alcántara, 2006), and to analyse other objective variables. With a view to overcoming the above problems and contributing to research on this area, our study aims to:

1. Identify the current problems of *pilota valenciana* players as regards protections and their attitude concerning the use of glove-type protection.
2. Know what players want from a protective material.
3. Identify specific aspects relative to comfort and performance in protections.
4. Study the distribution of the materials used by players over the hand in order to establish one or several standard configurations.

MATERIALS AND METHODS

The general sample consisted of 100 players from the Valencian counties. Subjects were selected based on their high competition level and a minimum experience of 3 years in *pilota valenciana*. The sample therefore included a large number of professional players (51). The professional players were all registered with the Pilota Valenciana Federation (the sample included 46% of the professional players registered in 2010). The remaining 49 were aficionado players. Table 1 shows data on the piloraris' personal features, and their experience and practice in this sport. Most of the subjects who completed the questionnaires usually played the *escala i corda* (64%) or *raspall* (34%) formats. In addition, the sample consisted of 45% players in the *rest* position and 44% played as *mitger.*

Table 1. Personal features and play experience of the sample of *pilota valenciana* players.

Personal data variables		
	Mean	SD
Age (years)	26.45	5.77
Weight (kg)	78.35	9.59
Height (cm)	178.24	6.64
Experience and practice variables		
	Mean	SD
Years playing	13.47	6.91
Hours of practice per week	6.44	2.77
Time per game (minutes)	81.05	19.64
Games per week (average)	2.90	0.83

n (men)	100

A questionnaire model was designed in order to collect information. It was produced by the Design and User Enquiries division of IBV –focused on consultancy, design and validation of these types of instruments from the social science area. The information and feedback collected by other similar studies in *pelota vasca* (Gámez, 2008) was most useful in preparing the initial questionnaire, which was also improved with a number of personal interviews with players. Finally, the questionnaire was validated by implementing it face-to-face with a *pilota valenciana* professional player with more than three years of experience. The time needed to complete the questionnaire was recorded with a chronometer and the adequacy of questions was verified. To do so, upon completion the participant was asked for his opinion on each item in the survey.

The final questionnaire included both open and closed questions, as well as multiple choice questions with a scale. The latter were assigned a 3 and 5 point Likert-type scale. The questionnaires were not administered in group but individually, as in an interview. The researcher read the questions and clarified doubts. It consisted of 70 items structured into the following categories:

- ✓ 5 items on personal aspects.
- ✓ 8 items on sports dedication.
- ✓ 57 items on technical data for the protections.

In the questions about the protections, two distinctive sections were differentiated: a section with questions on the performance, comfort and functionality of the traditional glove (weight; fit; elasticity; shock absorption and pressure distribution; sweat generated; time needed to make the protection and task satisfaction), and another one that made reference to the areas of the hand, and the amount and type of material used for each area. Information was also collected on the willingness to use a protective glove in the future.

To facilitate the collection and understanding of the data related to the amount and type of material used, the hand was divided into different protection sections, as shown in Figure 1. Likewise, the usual material types (cardboard, cards, Tesamoll®, sheets, leather, etc.) were classed into two types of materials depending on their hardness: soft material (Tesamoll®) and hard material (sheets).

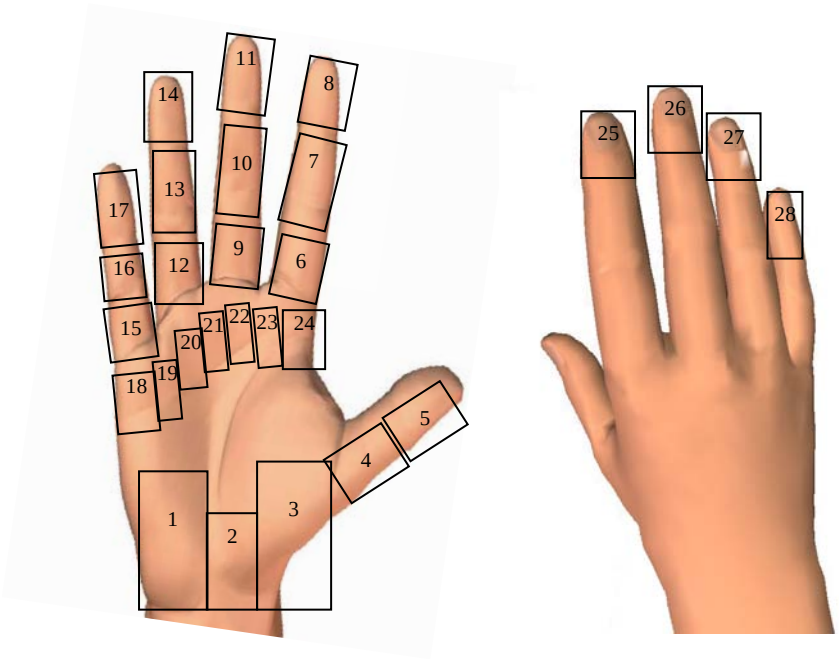


Figure 1. Hand areas protected by players.

Once the information was collected, data were statistically processed and analysed. To that end, variables were codified with the software ACCES XP, and the computer programme SPSS 14.0 was used for the subsequent statistical study. 56 variables were formed in relation with the type and amount of material used (grouped into soft/hard materials) in the making of the protections, each of them referring to some of the hand areas shown in Figure 1.

Before processing the information, undoubtedly atypical data were ruled out. We then proceeded to the analysis by means of descriptive statistics: Frequencies, fashions, means, maximum and minimum values, standard deviations, percentages and cumulative percentages. A factorial analysis was performed next. This multivariate statistical method was used to reduce, to just a few independent factors, the number of variables related to the type and amount of material. Thus, the information accounting for the total variance of the phenomenon was integrated, which made it more understandable and easier to handle. This technique required the variables relative to the amount of material to be re-coded in an ordinal way. They were ordered logically, from those with the least protection layers to those with the most layers and for each type of material (Table 2).

Table 2. Codification of amount of material used by players, for soft and hard materials.

Code	Soft material	Code	Hard material
0	No material	0	No material
1	Tesamoll, soft 1 layer	1	1 sheet
2	Tesamoll, hard 1 layer	2	2 sheets
3	Tesamoll, soft 2 layers	3	3 sheets
4	Tesamoll, hard 2 layers	4	4 sheets
		5	5 sheets
		6	6 sheets

The factorial analysis used a Varimax rotation: the extraction method used was the principal component analysis: 0.7 was chosen as the minimum self-value, and 0.75 was the minimum commonality. With the resulting factors, a main component analysis was performed, permitting to determine the number of groups and the number of subjects in each group that could be differentiated as regards the type and amount of protective material. This analysis included an ANOVA ($p<0.05$) which connected the factors obtained by the factorial analysis with the groups of subjects formed from the cluster. Thus, the factors with statistically significant differences ($p<0.05$) constituted the hand protection areas that defined differences between groups. In addition, to be able to take into consideration the groups formed, they had to be composed of 10% of the sample minimum. A preliminary condition for the analysis was the identification of two conglomerates, based on the hypothesis that differences could exist in the way the hands were protected in relation with the playing position (*rest/mitger*). These analyses were conducted both for the *raspall* modality and for *escala i corda*. This paper shows the findings and analysis of the former playing modality only, for reasons related to the article's length.

Lastly, to determine in the groups the amount of materials used in the areas of the hand (Figure 1), the mode was taken as the statistic of reference, evaluating its use in relation with the cumulative percentage for the mode and the remaining descriptive statistics (Tables 3 and 4).

RESULTS

RESULTS RELATED TO THE PERFORMANCE, COMFORT AND FUNCTIONALITY OF THE PROTECTIONS

As to the effect of the protections on performance, please note that 67% of players think that their protections worsen performance (Figura 2), and 88% of the sample even thinks that the protections have a negative influence on ball

control. Players believe the thickness and rigidity of the material to be the main cause of this (73%).

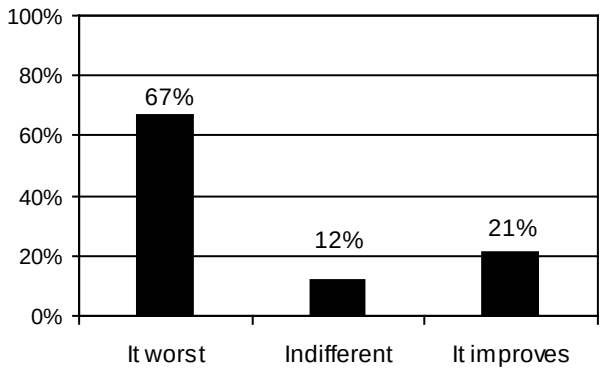


Figure 2. Effect of protections on performance.

Concerning the *pilotari*'s comfort, 36% think that the protections are uncomfortable while 44% believe they are comfortable or very comfortable.

17% say the protections are heavy or very heavy, and 47% would like them to be lighter. As for the fit, 92% believe it to be correct, and most players seem to like it (90%).

Elasticity, understood as the ability to move the hand with the protections on, is considered to be high or very high by 60% of players. However, 67% of the sample says they would like their protections to be more elastic.

Regarding shock absorption, a third of the sample (33%) would like the materials to be more absorptive. Similarly, 49% think that the materials used distribute pressures poorly or very poorly, while 56% say distribution ought to be greater.

As for the amount of sweat caused by the protections on the hand, a third of players approximately think they sweat too much. Besides, 84% would like to sweat less, especially on the palm of the hand (52%), or on the back of the hand (30%), as these are the sweatiest areas.

Data on the manufacture of the protections reveal that it is a laborious job: 84% of players take an hour or longer (Figure 3). In addition, 60% of the sample finds making the protections tiresome and complicated.

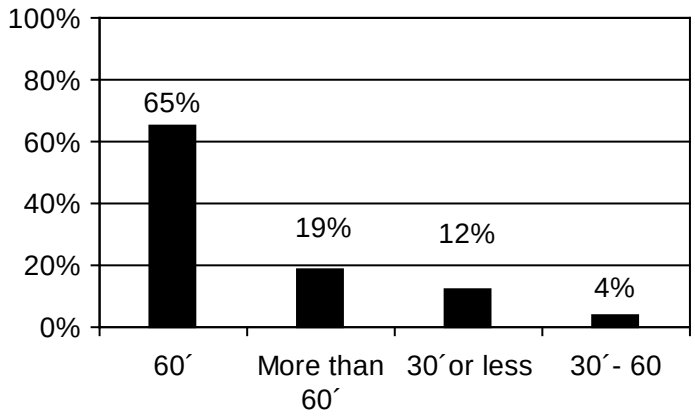


Figure 3. Time needed to make the protections.

Finally, 99% of the interviewees would buy a protective glove to play *pilota valenciana* if similar o better performance were ensured. For 88% of the sample, the glove ought to protect them against the cold. In fact, 85% of players say they are cold when playing with their current protections.

RESULTS RELATED TO PROTECTION AREAS

Regarding the study of the areas of the hand protected and the amount and type of material used in each area, the 56 variables display more that 0.75 commonality. In our study, the 56 variables were grouped into 11 factors accounting for 90.8% of the total variance.

From the 11 factors, factor 1 explains 23.17% of the total variance; it corresponds to the soft protective material placed on areas 4 to 17 (proximal, medial and distal phalanx of all the fingers) (Figure 1). Factor 2 covers areas protected by a hard material: numbers 2, 7, 8, 10, 11, 13, 14, 16, 17. Factor 3 also refers to a hard material, areas no. 18 to 24 in this case (metacarpal heads and intermetacarpal spaces). In turn, factors 4 and 5 make reference to distal phalanx areas behind the fingers, for the soft material (factor 4) and the hard one (factor 5) (from 25 to 28). Factors 6 and 8 refer to the protection of areas no. 18 to 25 with a soft material. Factor 7 applies in protection areas numbered 6, 9, 12 and 15 (proximal phalanxes), while factor 9 defines protection with a hard material in areas 4 and 5 (phalanxes of the first finger). Lastly, protection areas 1 and 3 (hand carpus) are explained by factor 10 for the soft material and by factor 11 for the hard one.

In turn, with the selection of 2 conglomerates, the programme makes 2 iteractions, while the ANOVA shows a single factor with statistically significant differences ($p<0.05$) between both groups. This factor consists of just one player. Tables 3 and 4 show the values of the modes in each protection area.

Table 3. Descriptive statistics of the soft material used by *escala i corda* players for the different protection areas of the hand.

SOFT MATERIAL									
Area	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
N Valid	57	57	62	63	63	62	63	63	63
Lost	7	7	2	1	1	2	1	1	1
Mean	1,04	0,81	2	2,37	2,30	2,37	2,33	2,33	2,44
Mode	0	0	2	3	3	3	3	3	3
S. Deviation	1,260	1,260	1,362	1,311	1,328	1,204	1,191	1,164	1,133
Cumulative % for the mode	51	57	65	80	80	82	82	83	82
Area	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
N Valid	62	63	63	62	62	63	62	63	58
Lost	2	1	1	2	2	1	2	1	6
Mean	2.40	2,38	2,38	2,39	2,42	2,24	2,27	2,32	2,19
Mode	3	3	3	3	3	3	3	3	3
S. Deviation	1,152	1,128	1,197	1,178	1,167	1,266	1,230	1,189	1,131
Cumulative % for the mode	82	83	82	82	82	83	84	83	83
Area	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
N Valid	58	60	58	58	57	57	64	64	64
Lost	6	4	6	6	7	7	0	0	0
Mean	1,64	1,33	1,71	1,48	1,72	2,23	0,33	0,36	0,31
Mode	0	0	0	0	0	3	0	0	0
S. Deviation	1,304	1,398	1,481	1,466	1,424	1,254	0,818	0,880	0,814
Cumulative % for the mode	30	43	30	35	25	83	82	82	84
Area	**28**								
N Valid	64								
Lost	0								
Mean	0.31								
Mode	0								
S. Deviation	0.814								
Cumulative % for the mode	84								

Table 4. Descriptive statistics of the hard material used by *escala i corda* players for the different protection areas of the hand.

HARD MATERIAL									
Area	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
N Valid	64	64	64	64	64	64	62	62	64
Lost	0	0	0	0	0	0	2	2	0
Mean	0,23	0,27	1,06	0,95	0,92	1	1,11	1,11	1,19
Mode	0	0	0	1	1	1	1	1	1
S. Deviation	0,611	0,761	1,194	0,785	0,783	0,816	0,749	0,749	0,794
Cumulative % for the mode	85	85	43	88	89	84	80	81	76
Area	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
N Valid	63	62	64	63	62	62	62	61	64
Lost	1	2	0	1	2	2	2	3	0
Mean	1,08	1,13	1,05	1,13	1,15	0,89	1,02	1,07	1,84
Mode	1	1	1	1	1	1	1	1	1
S. Deviation	0,822	0,793	0,785	0,833	0,765	0,812	0,820	0,793	1,144
Cumulative % for the mode	82	81	84	80	80	84	84	82	50
Area	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
N Valid	64	64	64	64	64	64	62	62	62
Lost	0	0	0	0	0	0	2	2	2
Mean	1,70	2	1,67	2,03	1,72	1,88	0,23	0,23	0,26
Mode	1	1	1	1	1	1	0	0	0
S. Deviation	1,108	1,127	1,196	1,126	1,161	1,162	0,556	0,556	0,571
Cumulative % for the mode	52	44	54	37	53	55	80	80	75
Area	**28**								
N Valid	62								
Lost	2								
Mean	0,24								
Mode	0								
S. Deviation	0,564								
Cumulative % for the mode	78								

DISCUSSION

The first phase of our project for the development of a glove-type protection sought to know the players' opinions, and to try and define the basic design requirements or specifications that had to be met by this piece of protective equipment. Among other things, players (33%) want better shock absorption in

the materials and better pressure distribution (56%). As is the case with other sports, improved shock absorption (Barnes and Smith, 1994; Barry, 1998; Clarke, Frederick and Cooper, 1983; James, Bates and Ostering, 1978; Llana, 1998; Milburn and Frederick, Clarke and Hamill, 1984) and a better distribution of pressures (Girard, Eicher, Fourchet, Micallef, and Millet, 2007; Henning and Milani, 2000; Sanderson, Henning and Black, 2000; Wong, Chamari, Mao, Wisloff and Hong, 2007) would contribute to reducing the high injury rate and discomfort of players. However, we must note that excessive shock attenuation might compromise the players' performance, currently considerably hindered by the protections (67%). In this respect, further research should first measure the level of shock absorption and pressure distribution of the protective material, to then choose the most adequate one.

One of the most notable aspects in relation to the worsening of performance is the high percentage of players (88%) who think that they do not control the ball adequately. These points to the need to develop protections to improve play quality. According to most of the players (73%), the greatest problem in adequately controlling the ball strike is caused by the thickness and/or rigidity of the protections, which means the future protective glove should be more elastic and less thick. Thickness would therefore be a key element for effectiveness. This is what happened with the design of a glove for Basque Pelota (Gámez, 2008), which did not fulfil players' requirements with regard to thickness specifications. In this study, 6 out the 9 players who participated in the validation of the glove considered it to be too thick, and for 78% of them the system developed failed to provide adequate ball control (Gámez, 2008). Along the same lines, for improved performance it might be positive to reduce the weight of the protections, as expressed by half of the sample, as this would favour hand mobility and subsequently the striking technique.

Concerning general comfort with the protections, it must be underlined that the percentage of discomfort associated by players to the protections is very high (36%), much higher than that of Basque pelota players (13.7%) (Gámez, 2008) and greater than that found for other sports. In the case of tennis shoes, only 9% of regular players find their shoes uncomfortable (Llana et al., 2002). Perhaps this evident discomfort is related to the high level of sweating produced by the protections. 84% would prefer gloves that do not make them sweat so much, as well as better mobility and elasticity, as stated by 67% of the sample. The percentage of discomfort associated to the protections is even more relevant when we consider that they are assessing a product made by them, in which case subjective perception tends to overestimate the evaluation positively.

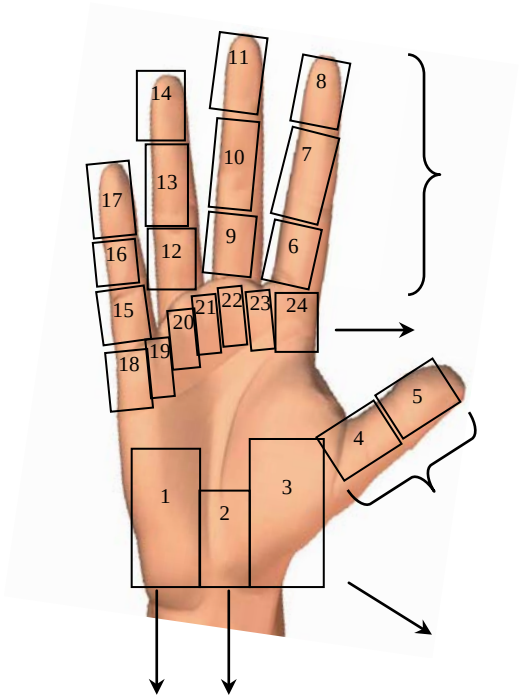
As far as thermal comfort is concerned, most players (85%) say their hands get cold, especially in winter. This causes circulatory problems that can hamper performance and may lead to discomfort and injuries (Castellani et al., 2006). In *pelota vasca*, a similar percentage of players (88.2%) say they have more pain when it is cold (Gámez, 2008). Therefore, the future protective glove should protect from the cold, as expressed by 88% of the *pilota valenciana* players. A

universal glove protecting from the cold and at the same time avoiding sweating in hot weather might not be possible, but summer and winter versions of the same glove might be viable.

As for the results related to protection areas, they are helpful indications for the design of an integrated protective solution and can contribute to identifying user groups with specific needs. For the studied modality, *escala i corda*, the analysis does not provide differences for glove configuration between players, since the factor with statistically significant differences ($p<0.05$) between the two groups is composed of one person only and therefore does not include the required number of players (<10%) for differences to be generalised. The configuration of the protective glove will be based on the majority group, analysing the modes (Figure 4). On the other hand, players playing as *mitgers* have a higher hand injury rate if compared to players in the *rest* position (73.53% vs 65.11%) (Montaner, 2010). This could be due to the fact that *mitgers* tend to volley more (above head level and without bouncing the ball previously) than *rest* players. In this type of strike, the velocity of the ball is greater, causing stronger, potentially damaging impacts on the palm of the hand, which would indicate that the glove for *mitgers* would have to be more protective. However, differences were not found in the configuration of the protections depending on the playing position (*rest* or *mitger*). Thus, a single basic configuration could be designed regardless of the position of *escala i corda* players.

´The design of a glove-type protection can avoid the drawbacks associated to making the protection (60% finds it complicated and tiresome and 84% take 1h or more to protect their hands) and can contribute to making the most of time regarding training and warming up before the game, this having a positive influence on performance and on the promotion of this sport.

Figure 4. Basic configuration of the *escala i corda* protective glove considering the value of the modes of the amounts of soft and hard material recorded in the questionnaires.



Phalanges:

Soft material: 2 layers of soft *tesamoll*

Hard material: 1 sheet

Head and spaces on metacarpals:

Soft material: 2 layers of soft *tesamoll*

Hard material: 1 sheet

First finger phalanges:

Soft material: 2 layers of soft *tesamoll*

Hard material: 1 sheet

Thumb carpal zone:

Soft material: 1 layer of hard *tesamoll*; Hard material: nothing

Pinky and scaphoid carpal zone:

Soft and hard material: nothing

*No protection on the back of distal phalanges of the fingers.

CONCLUSIONS

Current protections fail to meet the needs of players in terms of performance and comfort. Some of the drawbacks could be overcome with a protective glove based on the needs and preference referred to by players in the study. The almost unanimous acceptance of players (99%) in relation to the design of a future protective glove must be underlined.

The study of the distribution of materials in the hand allows us to define the amount and type of material that the future glove should have. The new protections would also fulfil the needs of most *escala i corda* players. In further studies, the protective glove designed will be validated using biomechanical tests intended to analyse palm pressures, comfort and performance.

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ANNEX (QUESTIONNAIRE MODEL)

SURVEY FOR THE DEVELOPMENT OF A *PILOTA VALENCIANA* GLOVE

This questionnaire is strictly CONFIDENTIAL.
Data shall only be used as part of a statistical analysis with a large population sample; under no circumstances reference shall be made to the information of a particular questionnaire.

1. PERSONAL DETAILS

NAME AND SURNAME _____
Age: _____ Weight: _____ Height: _____ Sex: 1. Male 2. Female

2. *PILOTA VALENCIANA* DEDICATION DATA

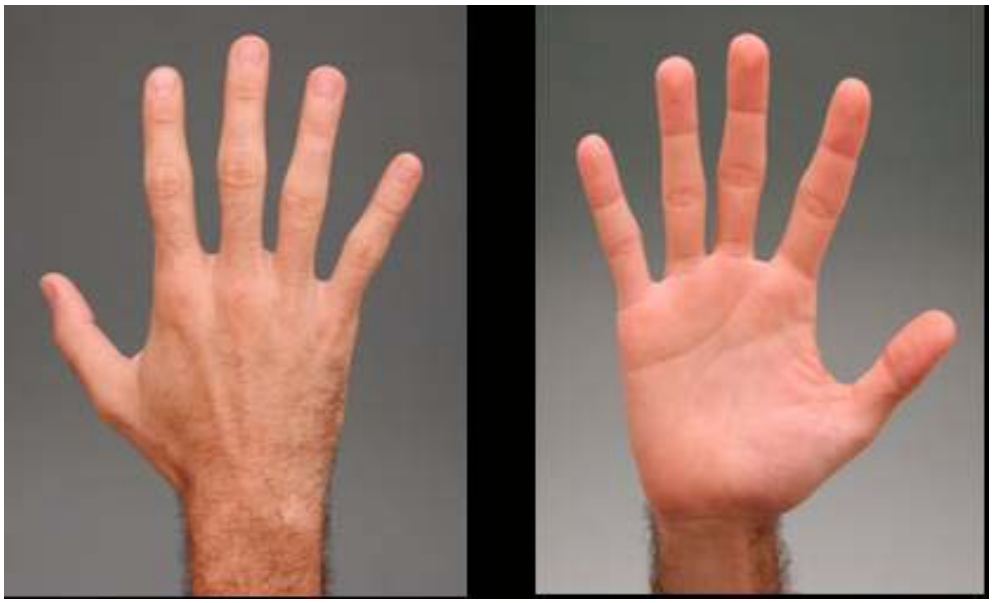
What was your sport CATEGORY last year?
1 Professional 2 Amateur
How many years have you been playing *Pilota valenciana*?
How many hours a week did you practise last year?
How many hours a week did you devote to training last year?
How many games and minutes per game approx. did you play per week?
Games per week ___ Minutes per game ___
What is your usual modality?
1 *Escala i corda* 2 *Raspall* 3 *Frontó* 4 Other: ___
Indicate your usual playing position:
1 *Rest* 2 *Mitjer* 3 *Punter*
What is your laterality?
1 Left-handed 2 Right-handed

3. DATA ON PROTECTIONS

PARTS OF THE PROTECTION
Do you use cream before putting the protections on? 1 Yes 2 No
What cream?:
1 LAVIT (sport-lavit)
2 Other: __

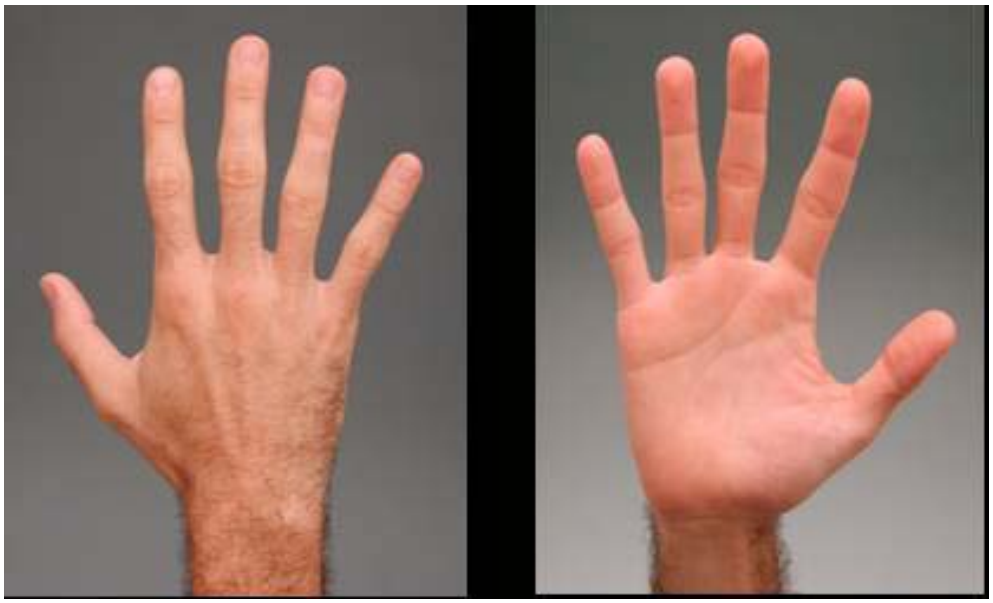
1ª Layer

Components:
1 Sticking plaster. Number of layers: ___
2 Tesamoll. Number of layers: ___
3 Double sided tape.
4 Sheets.
5 Playing cards. Number of layers: ___
6 Cartridges.
7 Other:__
PROTECTIONS DRAWING



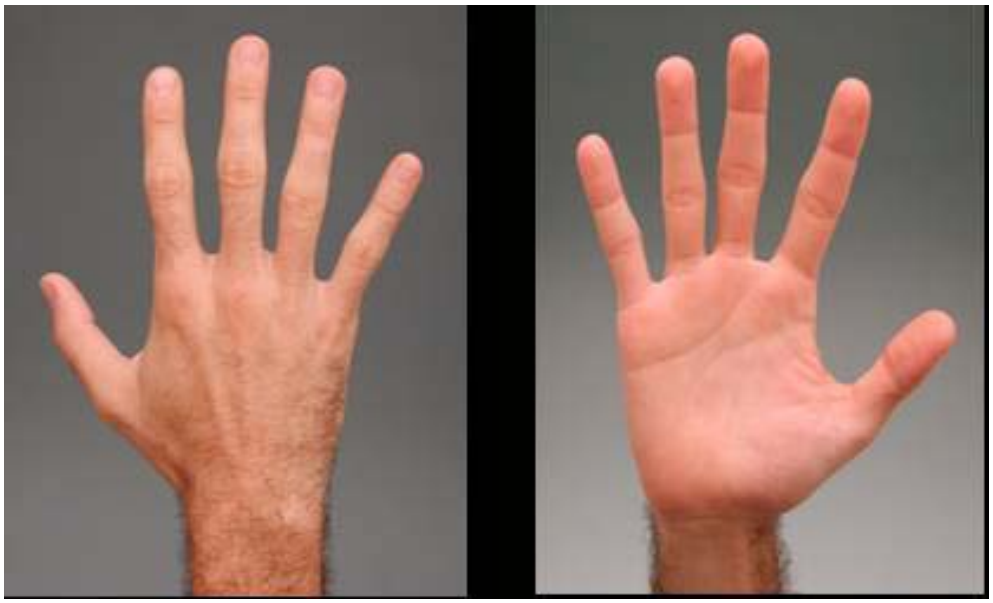
2ª Layer

Components:
1 Sticking plaster. Number of layers: __
2 Tesamoll. Number of layers: __
3 Double sided tape.
4 Sheets.
5 Playing cards. Number of layers: __
6 Cartridges.
7 Other:__
PROTECTIONS DRAWING



3ª Layer.

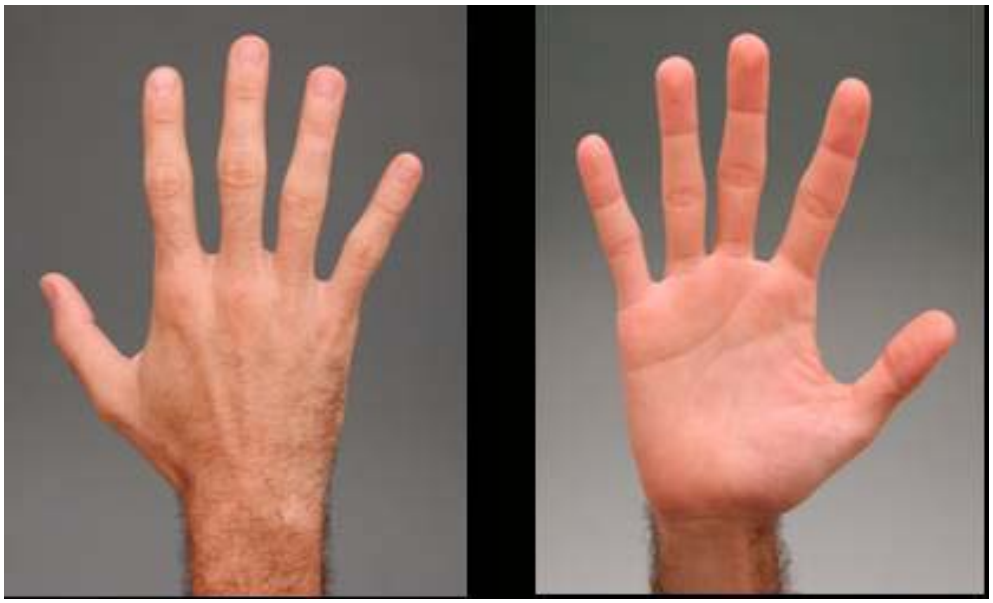
Components:
1 Sticking plaster. Number of layers: ___
2 Tesamoll. Number of layers: ___
3 Double sided tape.
4 Sheets.
5 Playing cards. Number of layers: ___
6 Cartridges.
7 Other:__
PROTECTIONS DRAWING



4ª Layer

Components:
1 Sticking plaster. Number of layers: ___
2 Tesamoll. Number of layers: ___
3 Double sided tape.
4 Sheets.
5 Playing cards. Number of layers: __
6 Cartridges.
7 Other: __

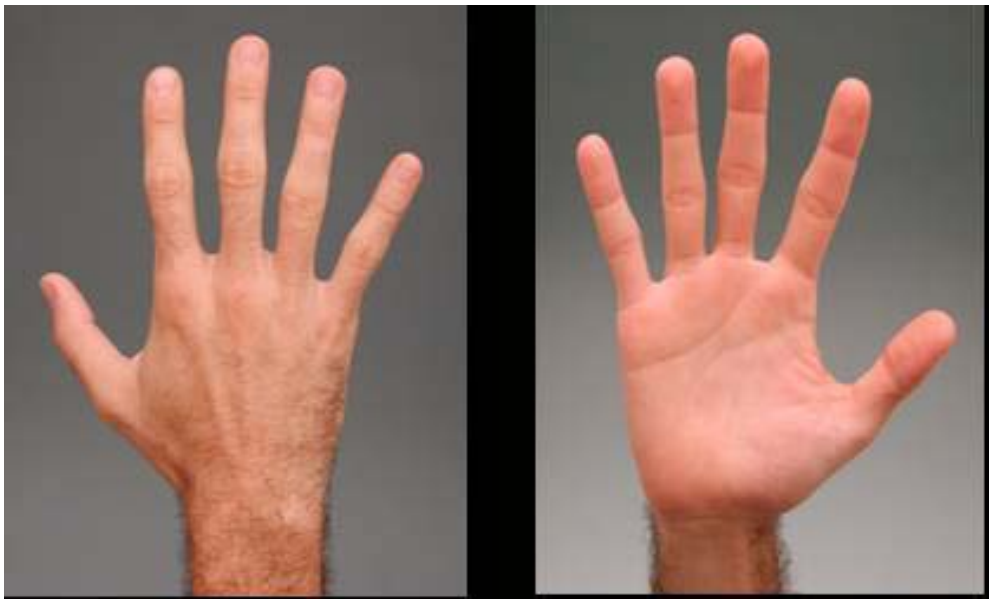
PROTECTIONS DRAWING



5ª Layer.

Components:
1 Sticking plaster. Number of layers: __
2 Tesamoll. Number of layers: __
3 Double sided tape.
4 Sheets.
5 Playing cards. Number of layers: __
6 Cartridges.
7 Other: __

PROTECTIONS DRAWING



On the shock adsorption material (Tesamoll):

- How many types of shock attenuation materials have you tried? _____

If you have used several types, please state why you changed materials. _____

- How many types of shock attenuation materials do you commonly use? _____
- Which ones?:_____ and _____
- Are you happy with the type of shock attenuation materials that you use? 1 Yes 2 No
- Do you think this material could be improved?
  2 No Why? 1 Yes. It could be improved.
- What should the material shapes be like?

1 Round 2 Square 3 Rectangular 4 Anatomical

- What do you think about the thickness of the protective materials?

1 Too thick 2 Thick 3 Neither thick nor thin 4 Thin 5 Too thin

- What thickness would you like?

1 Thicker 2 They are OK 3 Thinner

- What do you think about the shock absorption of the materials you use to protect your hands?

1 Too high 2 High 3 Adequate 4 Low 5 Too low

- How would you like it to be?

1 More cushioning 2 It is OK 3 Less cushioning

- What do you think about the **distribution of pressures** of the dressing materials that you use?

1 Very high 2 High 3 Neither high nor low 4 Low 5 Very low

- How would you like it to be?

1Greater distribution 2It is OK 3Less distribution

- How is the **fit** of the protective materials on your hand?

1 Very good 2 Good 3 Neither good neither bad 4 Bad 5 Very bad

- What do you think about the **hardness** (NEITHER RESISTANCE NOR A STRIKING FEELING) of the cushioning materials that you use?

  1 Very hard 2 Hard 3 Neither hard not soft 4 Soft 5 Very soft

- How would you like it to be?

  1 Harder 2 The same 3 Less hard

About the sheets that you use:

- How many types of sheets have you tried? ___
- If you have used several types, please state why you changed sheets. ___
- Where do you get your sheets from?

  1 I buy them. Where?

  2 People give them to me. Who?

  3 Others:

- How thick are the sheets you use? (in mm): ____
- How flexible are they?

1Very flexible 2 Flexible 3 Neither flexible nor rigid 4 Rigid 5 Very rigid

- How would you like the sheets to be?

1 Very flexible 2 The same 3 Less flexible

- Are you happy with the type of sheet that you use? 1 Yes 2 No
- Do you think they could be improved?

2 No. 1 Yes. They could be improved.

About the protections you use, in general terms:

- Do you think it is **heavy**?

1 Ver heavy 2 Heavy 3 Normal 4 Light 5 Very light

- How would you like it to be?

1 Heavier 2 They are OK 3 Lighter

- Is your hand **sweaty** when you use the protection?
- 1 Too much 2 Very much 3 Normal 4 Little 5 Very little
- How would you like it to be?

1 Bigger 2 The same 3 Smaller

- What areas are sweatier?

- How would you like the final **FIT** of the protections to be on your hand?

1 Very loose 2 Loose 3 Normal 4 Tight 5 Very tight

- Do you have the right fit with your protections?

1 Yes 2 No

- What do you think about the **elasticity** of the protections you use?

1 Very elastic 2 Elastic 3 Neither elastic nor rigid 4 Rigid 5 Very rigid

- How would you like it to be?

1 More elastic 2 The same 3 Less elastic

- Do you have the right elasticity with your protections?

1 Yes 2 No

Mark with an "X" the **AREAS THAT ARE WORN OUT THE MOST ON THE PROTECTIONS** that you commonly use.

- What do keep in mind when you buy the utensils for your hand protections?
  1 My personal experience
  2 Advice by experts
  3 Advice by colleagues
- How long does it take you to make the protections? _____minutes.
- How long does it take you to put the protections on (not the first time)? _____minutes.
- How long do you usually wear them for? _____minutes.
- Is it tiresome to prepare the protections?

1 Yes 2 No

- Would you buy a *Pilota* glove if you knew it behaved the same or better than the protections you normally use?

1 Yes 2 No

- How long do your protections last before you make new ones?

_____games. _____weeks.

- Do you use different protections for competing and training?
  1 Yes 2 No
- Do you think the protections should protect you from the cold?
  1 Yes 2 No
- Are you cold with your current protections?
  1 Yes 2 No
- How would you describe your protections, **comfort**-wise?
  1 Very comfortable 2 Comfortable 3 Normal (neither comfortable nor uncomfortable)
  4 Uncomfortable 5 Very uncomfortable
- How do your protections affect **performance**?
  1 It is a lot better 2 It is slightly better
  3 It is neither better nor worse 4 It is worse
  5 It is a lot worse

On the strike feel.

- Do you like feeling the ball? 1 Very much 2 A little 3 Not at all
- Do the protections have an effect upon control?

  1 Very much 2 A little 3 Not at all 4 A little 5 Very much

  What protection aspects have an influence?_____
- Any further **remarks** on the traditional protections?